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ABSTRACT

Suffolk County Community College has embarked on a three-year pilot project using multimedia learner-centered environments to deliver developmental mathematics. The project's outcome assessment model will measure the effectiveness of this delivery system, as well as student achievement in mathematics courses. New initiative funding was invested in college-wide faculty development producing over 70 staff members as participants in the project. Moreover, this venture capital supported the design, acquisition, and construction of three multimedia mediated-learning classrooms that can accommodate over 1200 mathematics students in a semester. This paper explores the development and design of this project. This paper describes the background, investigation, development of the plan, preparation of the funding rationale, preparation of faculty and facilities, designing the outcome assessment tools, psychometric analysis of the Mathematics Post-Test for this project. Three quasi-experimental studies are proposed which would identify any differential effects of Academic Systems Mediated Learning courses in Interactive Mathematics vs. the regular Developmental Math courses on basic arithmetic and algebra skills of two-year community college students. Overall, the study of Institutional Research Department establishes that scores on the Tri-Campus Mathematics Post-Test continuum can be reliably equated to some relevant cognitive or behavioral skill, specifically arithmetic and algebra skills. (VWC)

Instructional Technology Initiative for Developmental Mathematics Students

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Abstract: Suffolk County Community College (SCCC) has embarked on a three-year pilot project using multimedia learner-centered environments to deliver developmental mathematics. The project's outcome assessment model will measure the effectiveness of this delivery system, as well as student achievement in mathematics courses. New initiative funding was invested in college-wide faculty development producing over 70 staff members as participants in the project. Moreover, this venture capital supported the design, acquisition, and construction of three multimedia mediated-learning classrooms that can accommodate over 1200 mathematics students in a semester. This paper and M/SET 99 presentation explores the development and design of this project.

Background

In the Fall 1995 semester, SCCC Strategic Planning Committee focused on various aspects of College activities that would improve retention and recruitment of students while using efficient methods to deliver College services. In particular, attention was focused on the methods the College used to deliver developmental mathematics - specifically our three-contact hour MA01 Basic Mathematics course. Professors primarily lecturing to classes of size 15 teach arithmetic concepts. This course is followed by a second developmental course, a traditionally taught four-contact hour Algebra I (MA07). The Mathematics

Department felt that a more seamless approach to these courses could be developed allowing students to move more quickly and acquire the necessary mathematical skills to be successful in credit bearing courses. Attempting to meet these goals, MA06 - PreAlgebra and Algebra I, a combination of MA01 and MA07, was developed. Qualified students would be able to complete MA06 in one semester. This approach was not complete.

In the Spring 1996 semester faculty members, while attending the New York State Mathematics Association of Two Year College's (NYSMATYC) conference, discovered a product entitled *Interactive Mathematics* that was being developed and marketed by Academic Systems, Inc. This multimedia software and accompanying books could be used in teaching MA07, MA27 - Algebra II, and MA61 - College Algebra with Trigonometry courses. Academic Systems visited SCCC to present *Interactive Mathematics* to the Vice President Academic Affairs, Deans of Instruction, Area/Divisional Deans, and the Mathematics Department Heads. The Mathematics Department formed a college-wide faculty committee and an administrative group was charged by the Academic Vice President to investigate the use of this product in delivering MA01, MA07, and MA27 course material.

Investigation

The faculty committee visited a local college where *Interactive Mathematics* was being used and discussed the product with their colleagues. The Committee met during the summer of 1996 to draft a method to use this software in developmental mathematics courses initially to promote a seamless approach to these courses. The Committee decided that a completely new approach must be devised. A classroom that contains multimedia computer

technology for the student, collaborative workspace for the learner and instructor, and a mediated-learning approach to be incorporated by the teachers was envisioned. They agreed that a learner-centered environment is what was needed! The administrative group encouraged the faculty to pursue a NSF grant to fund the build of three mediated-learning classrooms with an eye on matching funding from SCCC.

Developing the Plan

The faculty committee proposed that the mathematics mediated-learning approach would need a LAN, a room with thirty multimedia pentium clients, a collaborative work area, a ceiling mounted multimedia projection system, software licenses, furniture, and require two faculty members (a teacher and a professional assistant) present for each class meeting.

A financial model was created that was used to explore the impact of funding this project. The model revealed that if a 7% increase in retention occurs through a mediated-learning in MA01 and MA07, SCCC could realize over a three-year period, additional revenue to financially support the project. Furthermore, the President, along with the Vice Presidents for Planning and for Academic Affairs requested that an outcomes model be designed to measure student retention rates, graduation rates, and mathematics achievement levels for those students using a mediated-learning approach as compared to the traditional class approach that students follow at SCCC throughout the project.

Preparing the Funding Rationale

The faculty effort in pursuing NSF funding was not successful but enabled them to solidify their ideas through the grant development process. Through a series of two smaller VATEA grants, the faculty were able to participate in a mentor development project employing *Interactive Mathematics*. These projects entitled *MathStar I & II*, began the acquisition of faculty multimedia computers, faculty training in learner-centered technology-based activities, and the formation of mentor relationships. Faculty went through a series workshop ranging from *Learning Windows 95*, *Selecting Mathematics Software*, and *Developing a HomePage*, to *What it takes to Mentor*, and *Successful Learner-Centered Modalities*. During AY9697 faculty and students reviewed the *Interactive Mathematics* product. SCCC partnered with Academic Systems to develop materials for MA01, entitled *Fundamentals of Mathematics*, and sent an administrative and faculty team to visit several community college sites that used *Interactive Mathematics* extensively. Furthermore, the mathematics mediated-learning project became part of the College's new initiative proposal for AY9798 and was considered as a venture capital project. A series of presentations was made to Suffolk County officials to familiarize them with the mathematics mediated-learning concept as a cutting-edge initiative and an investment in developmental mathematics teaching. In June 1997, the County approved \$325,00 for the Mathematics Mediated-Learning new initiative project for AY9798.

Preparing the Faculty and the Facilities

Through the help of a Mathematics Mediated-Learning Committee-at-Large (Vice President of Academic Affairs, Executive Deans, Deans of Faculty, Area/Divisional Deans, Department Head of Mathematics, Mathematics Faculty, and Academic Systems Inc.) within a seven-month period (July 1, 1997 - January 1998) the stage was set to begin teaching MA01, MA07, and MA27 using this approach. Job descriptions for the professional assistants were developed. Two three-day faculty-training sessions were held with over 110 faculty attending and over 70 completing the training. The Director of Instructional Research developed an outcome assessment plan that was approved by the Committee-at-Large. College-wide syllabi were agreed on and tests were developed. New initial rosters were developed containing students mathematics placement and achievement information. New final grade reports were created and College software was altered to handle the reporting of the grades. Student Advisement software needed to be altered to reflect the seamless approach being taken. Counselors were trained on the meaning of the new approach in mathematics. The first semester is completed! The faculty at SCCC are much more technologically literate. We will begin to see the initial outcomes by January 1999.



Figure 1: Fall 1997 faculty training session

Designing the Outcome Assessment Tools

Three quasi-experimental studies (Napoli 1997) are proposed which will lend support for the differential effects of Academic Systems Mediated Learning (ASML) courses in Interactive Mathematics (MALA, or MALI or MAL2) versus the regular Developmental Math courses (MA 01 or 07) on basic arithmetic and algebra skills of two year community college students. Study 1 will use a regression discontinuity design to test the effects of the ASUL arithmetic and algebra course and the corresponding regular developmental course on grades in a succeeding first level college math course (MA 21, 22, 23, 27, 41, or 47). Standardized math test scores and Mathematics Department Placement Test scores will be regressed against subsequent grades in a first level college math course for students whose College Placement Test (CPT) -Mathematics (a composite score based on the CPT Arithmetic and Elementary Algebra tests) test scores place them in either a regular developmental math course or in the ASML course. The regression findings for the classification variable should show a significant effect for instructional group suggesting a differential direct effect of the type of developmental course on grades in first level college math. The impracticality of random assignment necessitates the use of nonequivalent control groups and statistical control of potential confounding variables. Possible mortality bias will be ruled out in Study 2 using a nonequivalent control group design. The covariates to be addressed will include measures of skill and motivation (high school gpa; grades/scores in Sequential 1, 2, & 3; Verbal & Math SAT scores; CPT-R scores; educational goals; regular computer usage; recency of Sequential courses) and demographic variables (age, sex...). Study 3 will use a

pre-test/post-test design to assess the effectiveness of the two instructional approaches on improving arithmetic and algebra skills. Significant pre- to post-test gains should be found, and a greater differential gain for either group would indicate the superiority of that program. These results will form a critical multiplism indicating a differential overall effect for the type of developmental program should one exist.

Psychometric Analysis of the Mathematics Post-Test

Overall the study of Institutional Research Department (IRD) (Napoli, 1998) establishes that scores on the Tri-Campus Mathematics Post-Test continuum can be reliably equated to some relevant cognitive or behavioral skill, specifically arithmetic and algebra skills. This allows the test user (instructor, department, or administration) to appropriately deploy the tests as evaluative tools for designated courses. To accomplish this goal we assessed the Tri-Campus Mathematics Post-Test in terms of: 1) Inter-Item Reliability - a score referring to the degree of consistency among item scores within a test of a unitary factor, 2) Inter-Rater Reliability - a score allowing for the statistical examination of the adequacy of a scoring rubric, and 3) Construct and Concurrent Validity - a measure of the representativeness of the test in terms of the domain it was designed to assess and the comparability of the test scores with scores on other tests purporting to assess similar skills.

IRD found high inter-item reliability. This indicates high consistency or homogeneity across items, and allows for the claim that the tests are a reliable measure of mathematics proficiency. Additionally, we found high inter-rater reliability. Thus we established an interchangeability of judges. Moreover, we confirmed that the scoring rubric was sufficiently

defined to eliminate the subjective influence of scorer bias. Finally, we determined that the Tri-Campus Mathematics Post-Test have content, construct, and concurrent validity. Therefore we can claim that the tests do measure the arithmetic and algebra skills they purport to measure.

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